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SERIE: PLANKTON · BIND I

Nr. 5. Ove Paulsen: THE PERIDINIALES OF THE DANISH WATERS

KØBENHAVN
I KOMMISSION HOS C. A. REITZEL
BIANCO LUNOS BOGTRYKKERI
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THE PERIDINIALES

OF

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BY

OVE PAULSEN

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THE following list of Peridiniales from Danish waters has been compiled partly from my own observations, partly from the literature (especially "Bulletin des résultats acquis...") and partly from unpublished observations placed at my disposal by other authors. Of such unpublished papers I have made use of Dr. OSTENFELD's lists of plankton collected from Danish lightships and of notes and drawings from the hands of Dr. VAN BREEMEN in Helder, Mr. E. JØRGENSEN in Bergen, and Dr. LEVANDER in Helsingfors. I would offer these gentlemen my best thanks.

The Peridinales are classified by SCHÜTT into three families:

I. **Prorocentraceae** Schütt, 1896, p. 6.

The testa consists of two plates which like the shells Mytilus are hollow and fitted together along the margins (but without hinge). Two flagella at the front part of the body.[1] Chromatophores yellow.

Key to the genera:

A. Body rounded at both ends, without long spine or horn ..... I. *Exuviaella.*
B. Hind part of body as a rule pointed, front part broad, with a horn or long spine. II. *Prorocentrum.*

II. **Peridiniaceae** Schütt, 1896, p. 9.

The testa consists of an upper part (front part, epitheca) and a lower part (hind part, hypotheca), separated by the transverse furrow with its raised margins. The longitudinal furrow on the ventral side of the hypotheca stretches from the transverse furrow and behind. Only *Podolampas* has no furrows, but suture-lines indicate them. Testa as a rule divided into plates. The plates immediately in front of the girdle are called precingulars, those immediately behind the girdle postcingulars. The plates occupying the top and the bottom of the cell are named end-plates (bottom-plates). Chromatophores green, yellow or none.

Key to the genera:

A. Epitheca and hypotheca consist of two plates each, the whole testa being divided longitudinally into two by a ventro-dorsal (sagittal) suture. Girdle near the apical end of the cell, the epitheca much shorter than the hypotheca. No apical pore present. Along the longitudinal furrow are broad wings, supported by spines. The whole body is like a jug, the wings and spines of the longitudinal furrow being the handle (*Dinophyseae* Schütt).

Only one genus in the Danish waters ..... III. *Dinophysis.*

[1] SCHÜTT's orientation of the cell, with the suture-line horizontal as a girdle and the flagella-end considered as ventral part, seems to me unnatural. The cell would then move sideways.

B. No sagittal suture. Epitheca and hypotheca as a rule approximately equal in length. Apical pore present.

1. A girdle is present.

α. The body bears no hollow horns, but often solid spines.

† Testa not divided into plates, epitheca and hypotheca each covered with one undivided shell ..... IV. *Glenodinium.*

†† Testa divided into several plates.

§ Body spindle-shaped.

* Epitheca and hypotheca of about the same length ..... V. *Heterocapsa.*

** Epitheca considerably shorter than hypotheca ..... XI. *Oxytoxum.*

§§ Body not spindle-shaped.

* Body long, approximately isodiametric or somewhat depressed, not oyster-shaped.

aa. Hypotheca with two bottom-plates.

αα. Epitheca with five precingulars ..... IX. *Diplopsalis.*

ββ. Epitheca with seven precingulars ..... X. *Peridinium.*

bb. Hypotheca with one or three bottom-plates.

αα. Hypotheca with one bottom-plate.

Δ Longitudinal furrow not extending upwards to the apical pore.

Δ Membrane smooth ..... IX. *Diplopsalis.*

ΔΔ Membrane coarsely reticulate and spiniferous ..... VI. *Protoceratium.*

Δ Longitudinal furrow extends upwards to the apical pore. VII. *Gonyaulax.*

ββ. Hypotheca with three bottom-plates ..... VIII. *Goniodoma.*

** Body depressed, oyster-shaped ..... XII. *Pyrophacus.*

β. Hollow horns present.

† Longitudinal furrow not very broad ..... X. *Peridinium.*

†† Longitudinal furrow very broad, occupying a great part of the ventral side of the cell ..... XIII. *Ceratium.*

2. No girdle present, but a circular suture marks its place ..... XIV. *Podolampas.*

III. **Gymnodiniaceae** Schütt, 1896, p. 2.

Cell without testa, naked. Transverse and longitudinal furrow present. Chromatophores green, yellow or none.

Key to the genera:

A. One transverse furrow only.

1. No stigma with lens.

α. Girdle almost orbicular ..... XV. *Gymnodinium.*

β. Girdle a strongly ascending spiral ..... XVI. *Spirodinium.*

2. A stigma with lens present ..... XVII. *Pouchetia.*

B. Several (4—8) transverse furrows ..... XVIII. *Polykrikos.*

I. *Exuviaella* Cienk.

Exuviaella Lima (Ehrbg.) Bütschli 1885, tab. LI, fig. 2; *Cryptomonas Lima* Ehrenberg 1859, p. 793, 1873, fig. 24, 25; *Exuviaella marina* Cienkowsky 1881, p. 160, tab. III, fig. 36—37, Klebs 1884, fig. 10, 13—14, non Schütt 1895; *Dinopyxis laevis* Stein 1883, tab. I, fig. 27—33.

Dr. Kolderup Rosenvinge has shown me specimens of *Exuviaella Lima* fixed to algae and supported by a mucilaginous stalk. In some cases there were two cells upon one stalk. Cienkowsky mentions and figures both the free and the fixed stage, but he has seen no mucilaginous stalk.

Neritic species, common in the Danish waters, also in the Baltic, but not often captured in plankton.

II. *Prorocentrum* Ehrb.

Prorocentrum micans Ehrenberg 1833, p. 307. Bergh 1881, p. 260 f., fig. 56—59. Stein 1883, tab. I, fig. 1—13.

A neritic species, not seldom in the Danish waters, also in the Baltic.

III. *Dinophysis* Ehrenb.

Key to the species:

I. Anterior part of the body distinctly rising above the girdle ..... 5. *D. rotundata.*
II. Anterior part of the body not rising above the girdle.
A. Antapical end bears a spine ..... 1. *D. hastata.*
B. No antapical spine.
1. Cell broadest below the middle ..... 2. *D. acuta.*
2. Cell broadest about the middle.
a. Antapical end of the cell rounded, often with irregular protuberances ..... 4. *D. acuminata.*
b. Antapical end of the cell mostly acute and irregularly edged ..... 3. *D. norvegica.*

1. **Dinophysis hastata** Stein 1883, tab. XIX, fig. 12.
Rarely found in the Skagerak.

2. **Dinophysis acuta** Ehrenberg 1839, p. 124, 151, tab. IV, fig. 14.
It would perhaps be correct to apply Ehrenberg's name to the following species. His figure can represent either of them, but as *D. norvegica* is at any rate more common in the Baltic it is probable that it was this species he named *D. acuta.* But as this can scarcely be proved, the species must bear the names now commonly applied to them. — *D. acuta* is common in the North Sea, the Skagerak and the Kattegat, it seems rare in the Baltic, but as it is often confused with the following species its distribution is imperfectly known.

3. **Dinophysis norvegica** Claparède & Lachmann 1859, p. 407. tab. XX, fig. 19. Jørgensen 1899, p. 29, tab. I, fig. 3—6. *D. acuta* Bergh, Schütt e. a., vix Ehbg.

The annexed figures represent two geographical races of this species: var. *crassior* (fig. 1, *a*) from the Murman Coast and var. *debilior* (fig. 1, *b*) from the Baltic. The former is the one figured by Jörgensen. Length 60—64 μ. The latter is common in the Danish waters, also in the Baltic. The former has not been found here.

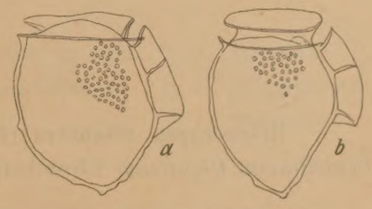

Fig. 1. *Dinophysis norvegica.*
a var. *crassior*, from the Murman Coast. *b* var. *debilior*, from the Western Baltic. $^{400}/_{1}$.

4. **Dinophysis acuminata** Clap. & Lachm. 1859, p. 408, tab. XX, fig. 17. Jörgensen 1899, p. 30, tab. I, fig. 7—8. ?*D. granulata* Cleve 1899, p. 37, tab. IV, fig. 7.

A neritic species, rather common in the Danish waters, also in the Baltic.

5. **Dinophysis rotundata** Clap. & Lachm. 1859, p. 409, tab. XX, fig. 16. Jörgensen 1899, p. 31. *D. Michaelis* auct. plur. vix Ehrenb.

Common in the Danish waters, also in the Baltic.

IV. *Glenodinium* (Ehrenberg) Stein.

Ehrenberg established this genus upon freshwater material with, as criterion, a red stigma. Stein on the other hand characterizes it by the homogeneous membrane.

Key to the species:

I. Cell triangular, with two antapical spines ..... 1. *G. bipes.*
II. Cell rounded, no spines or only one very small.
A. Cell depressed, epitheca much lower than hypotheca ..... 2. *G. Warmingii.*
B. Cell approximately globular, equally divided by the girdle ..... 3. *G. danicum.*

1. **Glenodinium bipes** Paulsen 1904, p. 21, fig. 3—4.

Rare. Found in the North Sea, the Kattegat and Baltic.

2. **Glenodinium Warmingii** Bergh 1881, p. 249 f., fig. 63—64.

Described by Bergh from the Little Belt, but as far as I know not found later.

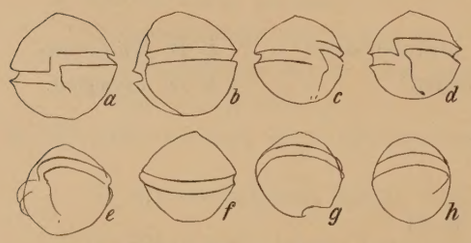

Fig. 2. *Glenodinium danicum.*
a—b one specimen, *c—h* another specimen in different views. From Skagen. 460/1.

3. **Glenodinium danicum** n. sp. (fig. 2).

Small, in front view almost globular. Girdle forming a left-handed spiral, with displacement more than the width of the girdle. Some (all?) specimens bear a very fine antapical spine at the left border of the longitudinal furrow (fig. 2, *c-e*). Length 32—36 μ.

It bears great resemblance to *G. cinctum* Ehbg., but it differs by the greater displacement and by the spine. Besides, *G. cinctum* is a fresh water-species. Pouchet (1883, p. 43, tab. XX—XXI, fig. 36) mentions a marine species of the same name. Upon one of the cells figured by him there is something like a delicate spine, but he does not mention it. The girdle in his figures is orbicular.

I have seen *G. danicum* once in many specimens, captured at Skagen in May 1903.

V. *Heterocapsa* Stein.

Heterocapsa triquetra (Ehbg.) Stein 1883, tab. III, fig. 30—40. Schütt 1895, tab. XXI, fig. 62. *Glenodinium triquetrum* Ehrenberg.

I have occasionally examined Icelandic specimens of this species with reference to its plates. The hypotheca (the pointed end) has two bottom-plates and five postcingulars, just like a *Peridinium*. As to

the epitheca I have reached no final decision. It seems to me that there are four or five end-plates and five or six precingulars, but my figures are not complete.

Not rare, but owing to its smallness seldom captured. Found in great masses in harbours, colouring the water (according to Dr. ROSENVINGE).

VI. *Protoceratium* Bergh.

Protoceratium reticulatum (Clap. & Lachm.) BÜTSCHLI 1885, p. 1007, tab. 52, fig. 2. *Peridinium reticulatum* CLAPARÉDE & LACHMANN 1859, tab. XX, fig. 3. *Protoceratium Aceros* BERGH 1881, p. 242, fig. 36. *Clathrocysta reticulata* (Clap. & Lachm.) STEIN 1883, tab. IV, fig. 4—5.

The annexed figures show different views. The hypotheca has one bottom-plate and five postcingulars. Yet a small plate,

Fig. 4. *Protoceratium reticulatum* from Skagen. One specimen.
a ventral, *b* antapical, *c, f, g* apical, *d, e* side view. x: a plate belonging to the longitudinal furrow. I-II supposed apical endplates. 1-7 precingulars of the epitheca. Reticulation not shown in *d-g*. 340/1.

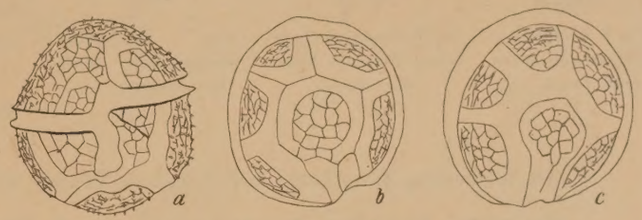

Fig. 3. *Protoceratium reticulatum* from Iceland. *a* ventral, *b* antapical, *c* apical view. 180/1.

close to the longitudinal furrow on the left side, is to be seen in fig. 3 *a b* and 4 *a*, but is not shown in fig. 4 *b*. To find out the plates of the epitheca has given much trouble. There are seven precingulars (figs. 4 *a*, *c-g*, marked 1—7) and properly one apical plate, but perhaps two, in figs. *f* and *g* (see also fig. *c*) marked I and II, — if they are really distinct plates I have not been able to decide. x (fig. 4 *a, c, f, g*) is a plate belonging to the longitudinal furrow.

Dr. LEVANDER has shown me figures of this species, drawn by him. As to the hypotheca they agree with my figures, but according to him the epitheca has only six precingulars and one end-plate.

Length 51—53 μ. Cell-content yellow.

Protoceratium reticulatum seems not to be rare in all the Danish waters, but owing to its small size it often escapes through the meshes of the nets. To be found also in the Baltic.

VII. *Gonyaulax* Diesing.

Key to the species:

I. Cell in front-view distally limited by a nearly straight line ..... 1. *G. polyedra.*
II. Cell distally rounded.
  A. Thecal wall covered with round poroids (porelike depressions).
    1. Coarsely poroid and spiniferous, so that the suture-line can hardly be seen. 2. *G. spinifera.*
    2. More finely areolated and poroid, the suture-lines are more prominent ..... 3. *G. polygramma.*
  B. Thecal wall reticulate (covered with angular areas) ..... 4. *G. triacantha.*

1. **Gonyaulax polyedra** STEIN 1883, tab. IV, fig. 7—9 (fig. 5, p. 8).

Length about 52—56 μ.

Rare in the Danish waters, found in the Kattegat and besides at Kiel.

2. **Gonyaulax spinifera** (Clap. & Lachm.) Diesing 1865, p. 382. Stein 1883, tab. IV, fig. 10—14. *Peridinium spiniferum* Claparède & Lachmann 1853, p. 405, tab. XX, fig. 4—5.

Fig. 6. Length about 70 μ.

Common in the Danish waters, also found in the Baltic.

Fig. 5. *Gonyaulax polyedra* from the Irish Coast. $^{400}/_{1}$.

Fig. 6. *Gonyaulax spinifera* from the North Sea, ab. $^{420}/_{1}$.

Fig. 7. *Gonyaulax polygramma* from the Atlantic. $^{440}/_{1}$.

3. **Gonyaulax polygramma** Stein 1883, tab. IV, fig. 14, non 16—17.

Fig. 7. Length 64—72 μ.

Rare in the Danish waters, but reported both from the Kattegat and from the Western Baltic.

4. **Gonyaulax triacantha** Jörgensen 1899, p. 35. Paulsen 1905, p. 21, fig. 5. Kofoid 1906, p. 102. *Ceratium*(?) *hyperboreum* Cleve 1900, p. 14, tab. VIII, fig. 14.

Rare. Found in the North Sea, the Skagerak and Kattegat.

An interesting Gonyaulax not found in Danish waters, is

Gonyaulax Levanderi (Lemmermann) emend. *Peridinium* sp. Levander 1894, p. 50, tab. II, fig. 21, *P. Levanderi* Lemmermann 1900. *Gonyaulax* sp., van Breemen 1905, p. 42. *G. spinifera* Levander, Bulletin des résultats ... Août 1903, p. 10.

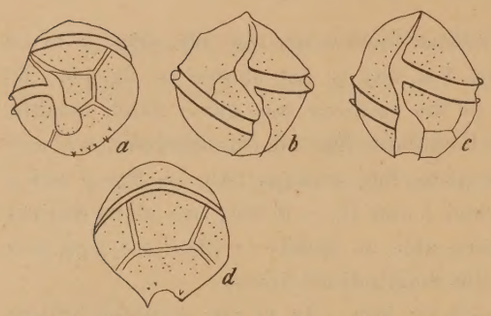

Fig. 8. *Gonyaulax Levanderi* from the Eastern Baltic. Copy of drawing by Dr. Levander.

The annexed figures 8, which are drawings by Dr. Levander, give an idea of the appearance of this species. It is related to *G. spinifera* but smaller, more thin-walled and finely reticulate. Length 36 μ, breadth 31 μ (according to Levander.

Found in the Eastern Baltic, the Zuidersee and at Iceland.

Levander points out (in a letter to the author), that this species has a great resemblance to *G. apiculata* (Pénard) Entz.,[1] and he considers the three species in question as a genetic series: *G. spinifera* in the sea, very spinous, *G. Levanderi* in the Eastern Baltic, with few spines, and *G. apiculata* in freshwater, without spines.

VIII. *Goniodoma* Stein.

Key to the species:

I. Body polyedric ..... 1. *G. polyedricum.*
II. Body rounded ..... 2. *G. Ostenfeldii.*

1. **Goniodoma polyedricum** (Pouchet) Jörgensen 1899, p. 32. *Peridinium polyedricum* Pouchet 1883, p. 42, tab. XX—XXI, fig. 34; *Goniodoma acuminatum* Stein 1883, tab. VII, fig. 1—16; non *Peridinium acuminatum* Ehrenberg 1838, p. 254, tab. XXII, fig. 16.

Recorded from Kiel and from the west coast of Sweden (Aurivillius 1896).

2. **Goniodoma Ostenfeldii** Paulsen 1904, p. 20, fig. 2.

Found in single specimens in the North Sea and Kattegat.

[1] 1904, p. 12, fig. 4 *a, b, d, f, g. Peridinium apiculatum* Pénard 1891, p. 51, tab. III, fig. 3 – 13.

IX. *Diplopsalis* Bergh.

1. **Diplopsalis lenticula** Bergh 1881, p. 244 f., fig. 60—62. Stein 1883, tab. VIII, fig. 12—44, tab. IX, fig. 1—4.

Common in the Danish waters except the Baltic, where it is more rare.

I give figures (fig. 9) of a small form (*forma minor* n. f.), which I formerly thought was another species. Its length is 36—41 μ, the greatest diameter 52—56 μ. In all respects except the dimensions and the bottom-plates it is quite like the common *D. lenticula*. The surface is finely dotted. It is the same form mentioned by van Breemen (1905, p. 160, 170) as *D. (? lenticula)*, and of which thanks to the kindness of the author I have seen figures. It seems to be the only *Diplopsalis* to be found in the Zuiderzee. I have found it not rarely in the Western Baltic, in the Kattegat and in great masses in a fjord in the Faeroes.

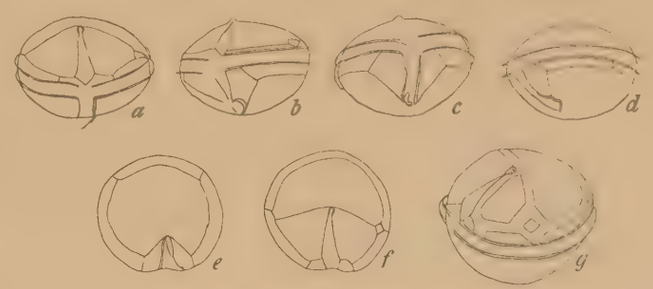

Fig. 9. *Diplopsalis lenticula* f. *minor* from the Faeroes.
a-*c* veetral views, *d* lateral view of the same specimen, *e* and *f* antapical and apical view of another specimen (a little schematic), *g* lateral view of a third specimen, from the left. $^{400}/_{1}$.

I suppose it is only a form of *D. lenticula*, because there is no limit between its dimensions and those of the common form, the latter varying in length between 44 and 60 μ. Besides, Bergh in his original description gives a length of 29 and 34 μ, and consequently it was the small form he had before him.

As to the arrangement of the plates we find it agrees pretty well with that indicated by Stein, the small accessory plate on the left side of the epitheca is not wanting. A slight difference is, that all the specimens examined by me had only one bottom-plate, whereas Bergh's specimens had two, as he gives seven plates for the hypotheca.

If we compare the epitheca with that of e. g. *Peridinium orbiculare* (fig. 10 *e*), we find about the same plates. The small accessory has grown larger, and there are two more precingulars. On these two precingulars depends in this case the maintenance of the genus *Diplopsalis*. Comparing e. g. the three species: *Peridinium Cerasus*, *P. monospinum* and *P. orbiculare*, we find that the number of end-plates of the epitheca decreases from 6 to 5 and 4. And if we consider some freshwater-*Peridinia*, we find e. g. *Peridiniopsis Borgei* Lemmermann[1] (doubtless a *Peridinium*) with 3, and *Peridinium umbonatum* var. *Elpatiewskyi* Ostenfeld[2] also with 3. According to Stein some specimens of *Diplopsalis lenticula* have also three end-plates, the small accessory being absent. Hence it can be seen, that the single criterion remaining for distinction between *Diplopsalis* and *Peridinium* is: five or seven precingulars. And here again we have *Peridinium catenatum* and "*Peridiniopsis*" *Borgei*, which have six. The difference mentioned by Schütt (1896, p. 18), that *Peridinium* has spines or horns, whereas *Diplopsalis* has none, is of no consequence, when we think of e. g. *Peridinium Thorianum*, which is quite destitute of spines and horns.

Consequently I believe that so far as the marine plankton is concerned, the distinction between the two genera *Peridinium* and *Diplopsalis* is of no systematic value. If I do not venture to propose the removal of the *Diplopsalis*-species to *Peridinium* it is only because I am not sufficiently familiar with the freshwater Peridinia.

[1] 1904, p. 134, tab. I, fig. 1—4. Lemmermann gives 5, but after his figures there are only 3 (plus the rhomb-plate)
[2] 1907, tab. I, fig. 9—12.

X. *Peridinium* Ehrenberg.

Two subgenera:

I. **Protoperidinium** Bergh (as genus).

The girdle forms a right-hand spiral (is nearer the apex on the right side). No antapical horns (except *P. Granii*).

Key to the species:

A. Antapical hollow horns present, bearing spines on their tips ..... 14. *P. Granii.*
B. No antapical horns, but often spines.
1. No spines present.
a. Shape of the cell globular.
α. Spiral of the girdle high, displacement more than the width of the girdle 1. *P. globulus.*
β. Spiral low, the girdle being almost orbicular ..... 2. *P. orbiculare.*
b. Shape of the cell not globular, but depressed, oblique..... 13. *P. excentricum.*
2. One or more antapical spines present.
a. One spine only..... 3. *P. monospinum.*
b. More than one spine.
α. Two antapical spines.
† Apical horn distinctly marked.
§ Small globular form..... 4. *P. Cerasus.*
§§ Larger elongated form ..... 10. *P. pedunculatum.*
†† Apical horn none or not distinctly marked.
§ Body low, depressed ..... 6. *P. ovatum.*
§§ Body ovoid or pyriform.
* Spines without distinct wings ..... 5. *P. roseum.*
** One or both spines support wings.
aa. Only the left spine supports a distinct wing ..... 7. *P. curvipes.*
bb. Both spines support wings.
αα. Body slender, terminating in an apical horn ..... 8. *P. Steinii.*
ββ. Body thicker, almost without apical horn ..... 9. *P. pyriforme.*
β. Three antapical spines, one to the right and two to the left.
† Smaller. The plane of the girdle is nearly at right-angles to the longitudinal axis ..... 12. *P. pellucidum.*
†† Larger. The plane of the girdle is oblique ..... 11. *P. pallidum.*

II. **Euperidinium** Gran.

The girdle forms a left-hand spiral (is nearer to the apex on the left side), or it is almost orbicular. Antapical horns often present.

Key to the species:

A. Antapical horns present.
1. The girdle is oblique to the longitudinal axis.
α. One of the antapical horns is longer and thicker than the other ..... 18. *P. claudicans.*
β. Antapical horns almost equal.
† Long and slender forms ..... 17. *P. oblongum.*
†† Short and depressed forms.

§ Antapical horns hollow ..... 15. *P. depressum.*
§§ Antapical horns solid ..... 16. *P. parallelum.*

2. The plane of the girdle is almost at right angles to the longitudinal axis.
α. Inner side of antapical horns with protuberances.
† Slender form. More neritic ..... 19. *P. divergens.*
†† Broad and short form. More oceanic ..... 20. *P. crassipes.*
β. Inner side of antapical horns smooth.
† Left border of longitudinal furrow forming a curve ..... 22. *P. conicoides.*
†† Left border of longitudinal furrow straight ..... 21. *P. conicum.*

B. No antapical horns.
1. Several cells form a chain ..... 28. *P. catenatum.*
2. Single cells.
a. Without antapical spines.
α. Membrane covered with semilunate papillae ..... 27. *P. Thorianum.*
β. Membrane reticulate or finely punctate.
† Membrane finely reticulate ..... 24. *P. subinermis.*
†† Membrane finely punctate ..... 25. *P. punctulatum.*
b. Antapical spines present.
α. Cell in apical view oblique, the left part being narrower than the right 23. *P. pentagonum.*
β. Cell not oblique.
† Small, length about 30—40 *μ* ..... 26. *P. achromaticum.*
†† Larger, length about 50—60 *μ* ..... 24. *P. subinermis.*

1. **Peridinium globulus** Stein 1883, tab. IX. fig. 5—8. Schütt 1895, tab. XV, fig. 48. ? *P. sphaericum* Murray and Whitting 1899, p. 328, tab. XXX, fig. 1.

All globular Peridinia generally have been called *P. globulus.* But it is very doubtful if this species is to be found in the northern waters, — Stein's figures all represent specimens from southern waters, and I have never seen a *Peridinium* which is like any of them.

On the other hand three small globular Peridinia are to be found in our waters, they will be described in the following.

2. **Peridinium orbiculare** n. sp. (fig. 10).

Small, globular, without spines and apical horn, and with nearly orbicular girdle, i. e. girdle without displacement.

The broad striate suture-lines, the wing on the left edge of the longitudinal furrow, the few end-plates of the epitheca are also characteristic features of this small *Peridinium*, which is quite destitute of spines.

Length 40—46 *μ*.

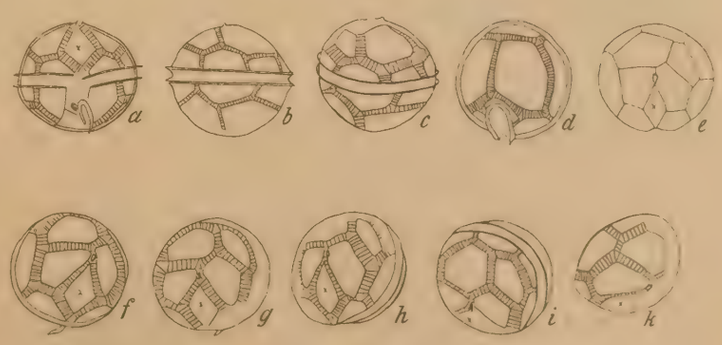

Fig. 10. *Peridinium orbiculare* from Valencia Harbour. *e* Diagram of apical plates. The others: Different views of the same cell, *a* ventral, *b*, *c* dorsal, *f-k* apical views. x is the rhomb-plate $^{420}/_{1}$.

Different from *P. globulus* by the dimensions, the orbicular girdle and by having only four end-plates to the epitheca, — and from the two following species by the want of spines and apical horn.

I have seen this species repeatedly in single specimens in the Danish waters and in Valencia harbour (Ireland). Besides, I have seen figures by VAN BREEMEN, representing specimens from the south-western North Sea.

3. **Peridinium monospinum** n. sp. (fig. 11).

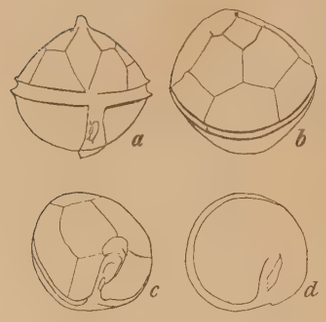

Fig. 11. *Peridinium monospinum* from Horns Reef.
Different specimens. *a* ventral, *b* dorsal-apical, *c-d* antapicat view. Ca. $^{400}/_{1}$.

Small, globular, with apical horn, one antapical spine and nearly orbicular girdle.

The epitheca ends in a distinctly differentiated apical horn. At the right border of the longitudinal furrow a spine is to be found, supporting a horizontal hyaline wing. The surface is finely granular. The arrangement of the plates of the hypotheca is the normal for the genus, but on the epitheca there are only two dorsal intercalary plates, not three, which is the normal (five end-plates instead of 6). Length 48—56 μ. Colour not ascertained.

I have twice seen this species in several specimens, in samples gathered at Horns Reef Lightship (in the North Sea, off Esbjærg) in July 1905. It is closely related to *P. minutum* Kofoid (1907, p. 310, pl. XXXI, fig. 42—45), differs by its larger dimensions, by the horizontal wing and by having only one spine, not three. Also *P. minutum* has only two dorsal intercalary plates.

4. **Peridinium Cerasus** n. sp. (fig. 12).

Small, globular, with apical horn, two antapical spines and girdle with displacement. Figs. 12 *a-d* give an idea of the appearance better than a detailed figure. The apical horn is distinct, well marked. The girdle forms a right-hand spiral, the displacement is about $^{1}/_{2}$—$^{3}/_{4}$ of the width of the girdle. The spines are a little remote from the end of the longitudinal furrow; the left one bears a very fine hyaline vertical wing (not shown in the figures). Figs. *e-g* give the arrangement of the plates, which is the normal for the genus. The only peculiarity is, that the first precingular on the left side is very small and intercalated between the girdle and the rhomb-plate. (I have found it so in the three specimens whose plates I have examined).

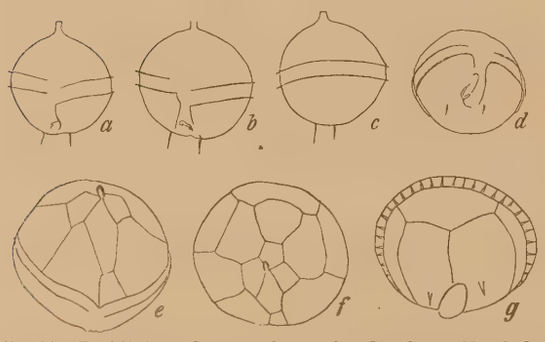

Fig 12. *Peridinium Cerasus* from the Southern North-Sea. *a* one, *b-d* another specimen ($^{400}/_{1}$), *e-f* apical, *g* antapical view (ab. $^{700}/_{1}$).

Length about 40 μ. Colour not ascertained.

P. Cerasus reminds one somewhat of *P. roseum* but it is distinguished by its small size, round shape and distinctly marked apical horn.

P. Cerasus seems to be common. I have seen it repeatedly in abundance in the southern North Sea in Aug. 1906, sporadically at Iceland.

5. **Peridinium roseum** PAULSEN 1904, p. 23, fig. 9.

Found very seldom in winter time in the Kattegat and the Skagerak.

6. **Peridinium ovatum** (Pouch.) SCHÜTT 1855, tab. XVI, fig. 49. GRAN 1902, p. 185, 187, fig. 11. *Properidinium ovatum* POUCHET 1883, p. 35, tab. XVIII—XIX, fig. 13.

Oceanic species, in the Danish waters frequent, occurs also in the Western Baltic, but rarely.

A small (neritic?) form has the name:

f. *minor* CLEVE, Bull. des résultats acquis, Mai 1904.

7. **Peridinium curvipes** (Ostf.) Ostenfeld 1906, p. 15. *P. decipiens* (?) var. *curvipes* Ostenfeld 1903, p. 581, fig. 128.

In this species (fig. 13) each border of the longitudinal furrow is continued by a spine, the left one supporting a wing. Both spines or only the left one curved. By this curved spine and by the lesser height of the cell, *P. curvipes* can be distinguished from *P. Steinii*.

Fig. 13. *Peridinium curvipes* from Skagen (in May). 400/1.

Height 48—52 μ without spines.

I have seen this species from the North Sea and the Skagerak, and besides from the coasts of Greenland, Iceland and the Faeroes. Perhaps there are more species closely allied to it.

8. **Peridinium Steinii** Jörgensen 1899, p. 38. *P. Michaelis* Stein 1883, tab. IX, fig. 9—14; Schütt 1895, tab. XIV, fig. 46 et auct. plur, non Ehrenberg.

Fig. 14 *a-b* represent the type form of this species (Stein, l. c, fig. 10, 12—14). Fig. *b* shows that a wing supported by the left spine extends upwards along the left border of the longitudinal furrow.

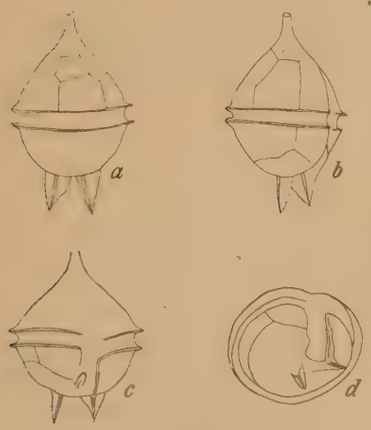

Fig. 14. *Peridinium Steinii*.
a-b two specimens from the Bay of Biscay in dorsal and right lateral view, *c-d* one specimen from the Western Baltic in ventral and antapical view. 400/1.

Length 48—52 μ without spines, these are 12—16 μ long. Thecal wall very distinctly reticulated with small meshes (not shown in the figure). In contradiction to the statement of Stein I have found the epitheca consisting of all the plates normal for the genus, i. e. seven precingulars, rhomb-plate and six endplates. According to Stein there should be only five endplates, but at any rate this cannot be normal for the species.

This typical form I have not seen in the Danish waters. The material for Steins's figures came partly from Kiel.

Fig. 14 *c-d* is from the Western Baltic (Gjedser) and perhaps identical with Steins's fig. 9 and 11. Length withont spines 45—52 μ (spines 9—12 μ).

This form is not rare in the Danish waters, it has been found in the Kattegat and the Skagerak.

The *Peridinia* previously described and figured by me as *P. Steinii* must, I think, be excluded from this species; for *P. Steinii f. brevis* Paulsen 1905 p. 4. fig. 3 *a-c* and *f*, I propose the name *P. breve* (not found in Danish waters), and the other form described there must bear the following name:

9. **Peridinium pyriforme** (Paulsen). *P. Steinii f. pyriformis* Paulsen 1905, p. 4 fig. 3 *d-e*.

Fig. 15 gives an idea of its appearance.

Length of this specimen without spines 70 μ (spines 6 μ). It differs from the preceding species by the dimensions, by the shape, being much thicker, and by the almost rectilinear outline of the epitheca. The spines are sometimes longer than in the specimen here figured (see the figures cited above). Here as in *P. Steinii* the left spine supports a vertical wing which follows the left border of the longitudinal furrow.

P. pyriforme has been found rarely in the Kattegat.

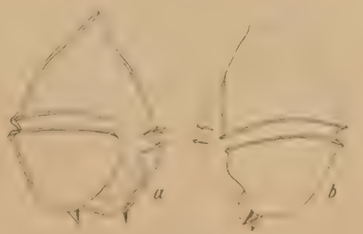

Fig. 15. *Peridinium pyriforme* from the Kattegat. 400/1.

10. **Peridinium pedunculatum** Schütt 1895, tab. XIV, fig. 47. Jörgensen 1905, p. 110, tab. VIII, fig. 29. ? *P. rectum* Kofoid 1907, p. 311, tab. XXXII, fig. 48—49.

Nearly related to *P. Steinii*, distinguished by the apical horn being distinctly marked. A specimen measured was 56 μ long, JÖRGENSEN has 51 μ (+ 17 μ for the spines).

Seems to be an Atlantic species which is rarely observed in the Skagerak.

11. **Peridinium pallidum** OSTENFELD 1899, p. 60, 1903, p. 581, fig. 130—131. ? *P. tridens* EHRENBERG 1840, p. 201.

The species seems to be rather variable.

The form of the epitheca may be more or less concave, the suture lines narrow or broad, the spines longer or shorter. As a rule there are two spines on the left side, one on the right, but single specimens may bear two spines on each side. From the left spine a wing extends upwards along the left border of the longitudinal furrow.

P. pallidum contains small yellow chromatophores.

Common on the North Sea, the Skagerak and the Kattegat, more sporadic in the Belts and the Western Baltic.

12. **Peridinium pellucidum** (BERGH) SCHÜTT 1895, tab. 14, fig. 45. OSTENFELD 1903, p. 581, fig. 129, non Gran. *Protoperidinium pellucidum* BERGH 1881, p. 227 f, fig. 46—48, non POUCHET nec VANHÖFFEN.

The spines and wings are arranged in the same manner as in *P. pallidum*, to which *P. pellucidum* has much resemblance. It is smaller and more neritic.

Common in Danish waters, also in the Baltic.

Peridinium decipiens JÖRGENSEN 1899, p. 40 (without figure); ? GRAN 1902, p. 187, fig. 12, ? O. PAULSEN 1904, p. 24, fig. 11.

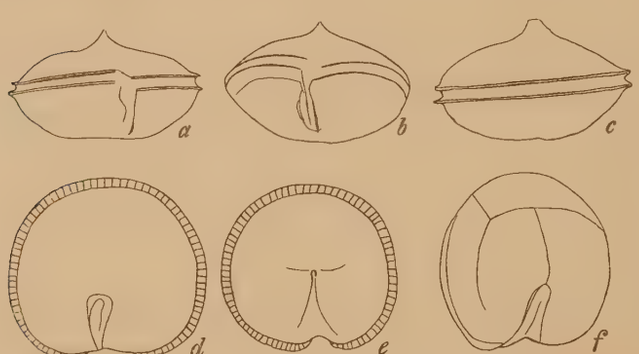

Fig. 16. *Peridinium decipiens* from Osterfjord by Bergen. *a—b* ventral, *c* side view, *d* and *f* antapical, *e* apical view. Arrangement of plates only in *f* indicated. $^{850}/_{1}$.

fig. 12, non JÖRGENSEN. The most characteristic features of this species are: body flattened, apex excentric, girdle twisting to the right, with small displacement, left border of longitudinal furrow more prominent and bearing a wing, right border wingless. Cell-content pink-coloured. Surface finely dotted. Height ca. 36 μ, greatest diameter 53—60 μ. VAN BREEMEN has $h = < 40\ \mu$, breadth 40—56 μ. It seems to be a neritic species, found by van BREEMEN in the North Sea and at Helder, by me in Valencia harbour (Ireland), the North Sea, the Kattegat and the Western Baltic, but always in single specimens.

Fig. 16 is drawn from authentic specimens originating from the Norwegian west coast at Bergen and procured by Mr. JÖRGENSEN. The surface is finely dotted. As JÖRGENSEN has given a detailed description of the species, I may refer to that description and to my figures. Height 44—56 μ, greatest diameter 75—96 μ. I am not sure that the figures cited by GRAN and O. PAULSEN really belong to this species. As to *P. decipiens var. curvipes* OSTENFELD see: *P. curvipes*.

P. decipiens has not been found in Danish waters.

13. **Peridinium excentricum** n. sp. (fig. 17).

P. decipiens van BREEMEN 1905, p. 43,

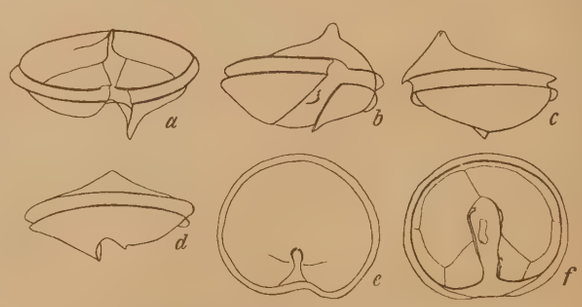

Fig. 17. *Peridinium excentricum* from Valencia harbour. Different views of the same cell: *a—b* ventral, *c* left lateral, *d* dorsal, *e* apical, *f* antapical. ab. $^{450}/_{0}$.

14. **Peridinium Granii** Ostenfeld 1906, p. 15, nom. nud. *P. sp.* Gran 1902, p. 188, fig. 13.

This species is represented in fig. 18. It cannot be confused with any other species of *Peridinium*, the almost cordate shape of the body being very characteristic. Among the species of the subgenus Protoperidinium *P. Granii* is remarkable by its two hollow antapical protuberances, as are found e. g. in *P. depressum*. The spines terminating the protuberances are distant from the longitudinal furrow. The girdle forms a right-hand spiral, the displacement being equal to the width of the girdle or a little less. The arrangement and number of the plates is the normal for the genus, it seems to be characteristic for this species, that the second pair of precingulars (from the rhomb-plate) are very broad and touch the rhomb-plate. The surface is very finely areolate. Length (including spines) 52—60 μ.

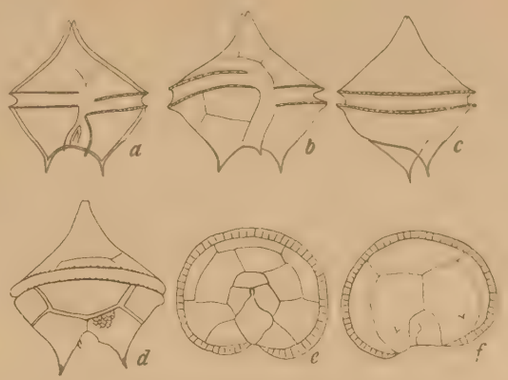

Fig. 18. *Peridinium Granii* from the Minch. Different cells. *a—b* ventral, *c* right lateral, *d* dorsal, *e* apical, *f* antapical view. $^{400}/_{1}$

P. Granii is a neritic species. It has been found in many places. I have myself seen it in samples from the Murman Coast, Iceland, the North Sea, Kattegat, the English Channel and the Minch. Only from the last named locality have I seen it in considerable quantities (May 1905).

Related to this species is:

Peridinium finlandicum n. nom.

P. divergens Levander 1894, 1, p. 51, tab. II, fig. 23, non Ehbg.

P. divergens var. Levanderi Lemmermann 1900.

The last name was given to a figure only and can not be retained, because another drawing of Levander's has been called *P. Levanderi*, viz. the first figure of *Gonyaulax Levanderi* (see this paper p. 8).

Dr. *Levander* has been so kind as to send me a plankton-sample containing this *Peridinium*, together with figures, some of which are reproduced in fig. 19. In the form of the body and in the position of the antapical spines *P. finlandicum* is like *P. Granii*, from which it is mainly distinguished by the lower curve between the spines and by the dimensions. Perhaps it is a starvation-form of *P. Granii*. The cell-content is colourless according to Levander's statement Length 31—53 μ.

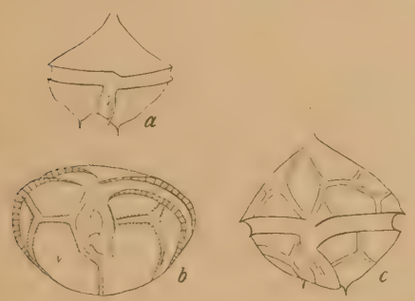

Fig. 19. *Peridinium finlandicum* from the Eastern Baltic. Copied from drawings by Dr. Levander.

P. finlandicum is a Baltic species, found at the coasts of Finland. It has not been found in the Danish waters.

15. **Peridinium depressum** Bailey 1855, p. 12, fig. 33, 34. ? *P. divergeus var. reniforme* Ehrenberg 1854, tab. 25 A, fig. B, 1854,2, p. 240.

Common in the Danish waters, occurs also in the Baltic, but it seems more seldom there.

16. **Peridinium parallelum** Broch 1906, p. 153, fig. 2.

Very like the preceding species, but easily distinguishable by the solid antapical horns.

A boreal species, found sometimes in the spring in the Skagerak.

17. **Peridinium oblongum** (Aurivillius) Cleve 1900, 1, p. 20. *P. divergens* var. *oblongum* Aurivillius 1898, p. 96. *P. divergens* var., Bergh 1881, fig. 39, 40. *P.* (*depressum* subsp.) *oceanicum* forma *oblonga* Broch 1906, p. 155, fig. 4.

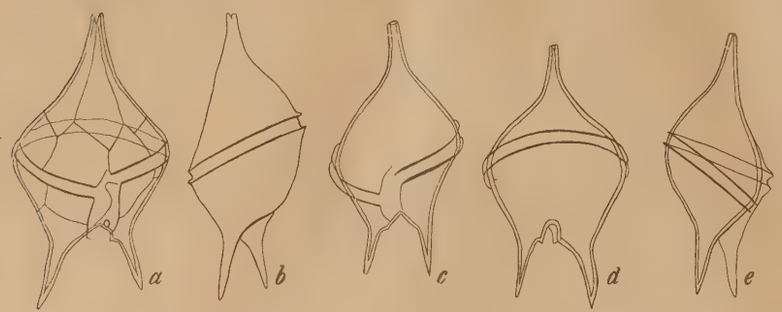

Fig. 20. *Peridinium oblongum*.
a-b one specimen from the Kattegat, in ventral and left side view. *c-e* another specimen from the Skagerak, in ventral, dorsal and right side view. Arrangement of plates indicated only in *a*. 220/1.

Fig. 20 represents two specimens. According to my measurements the length of this species is 118—136 μ. Broch has 130—170 μ. From Dr. van Breemen I have seen a drawing of a form with the antapical horns more closely together and 100 μ long, 60 μ broad.

In the Danish waters rather seldom, not found in the Baltic.

Nearly related to *P. oblongum* is

Peridinium oceanicum Vanhöffen 1897, tab. V, fig. 2. *P.* (*depressum* subsp.) *oceanicum* Broch 1906, fig. 3. Vix. *P. elegans* Cleve 1900, 2, p. 16, tab. VII, fig. 15—16.

This is an Atlantic species, larger (length 220—240 μ, after Broch 270—300 μ) and more slender than the preceding, but in other respects like it (Fig. 21). The two species therefore might as well be considered as varieties, — *P. oceanicum* as first named should then be the main species.

Not found in the Danish waters.

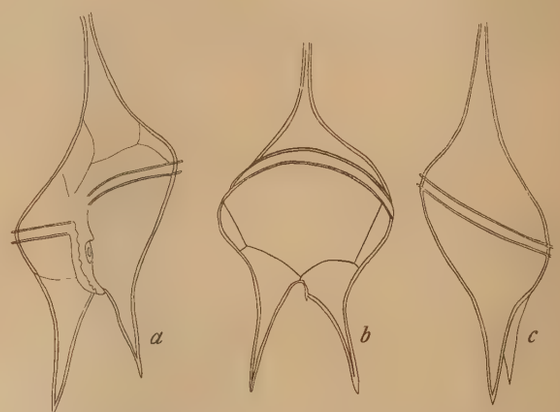

Fig. 21. *Peridinium oceanicum* from the Atlantic.
The same specimen in ventral (*a*), dorsal (*b*) and right side view (*c*). Arrangement of plates partly indicated. 220/1.

18. **Peridinium claudicans** n. sp. (fig. 22).

Belongs to the depressum-group, having hollow antapical horns and an oblique girdle. It is shorter and broader than *P. oblongum*, and the right antapical horn is longer and thicker than the left one. The cell-content is pale-yellow. Length about 96 μ.

I have found this Peridinium in rare specimens in the port of Frederikshavn, on the east coast of Jutland. Dr. van Breemen has found it also rarely in the Zuidersee (see: van Breemen 1905, p. 33, N. 117).

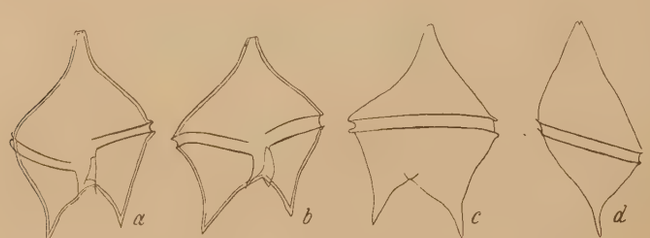

Fig. 22. *Peridinium claudicans* from Frederikshavn.
The same specimen in ventral (*a-b*), dorsal (*c*) and right side view (*d*). Arrangement of plates not indicated. 220/1.

19. **Peridinium divergens** Ehrenberg 1840, p. 201, 1844 (Monatsber. d. Berl. Akad.) p. 76, citing fig. 7, tab. VI of Müller 1841. Bergh 1881, p. 234 partim, fig. 41—42, non 43—45. Stein 1883, tab. X, fig. 1—7 (non 8—9), tab. XI, fig. 1—2, et auct plur. exp. — *P. divergens* var. *lenticulare* Ehrenberg 1854, p. 240 (citing the same figure of Müller). *P. lenticulare* Jörgensen 1899, p. 37, exp.

Fig. 23 represents what in my opinion is to be called *P. divergens*. From the descriptions of EHRENBERG it is impossible to see with cert inty which form he had before him, and STEIN's figures represent different species. The species here figured by me is the common one in our inner waters and therefore probably that described by EHRENBERG "Cilonii in baltico mari".

It will be seen that the shape is rather slender. The protuberances on the inner side of the antapical horns are small, sitting on the proximal part of the horns. The surface is finely reticulate and spiniferous (not shown in the figures).

As far as I know, the cell-content is yellow, often with red lumps or drops of oil.

Length 80—84 μ.

The original description of EHRENBERG (1840) is as follows: Peridinium flavum, lorica cordato-ovata laevi, frontis aculeis duobus acutis basi dentatis divergentibus, postica parte attenuata, tanquam breviter cornuta. Magn. $^1/_{48}$".

It must be remembered that EHRENBERG regarded the front as hind part. His description fits well

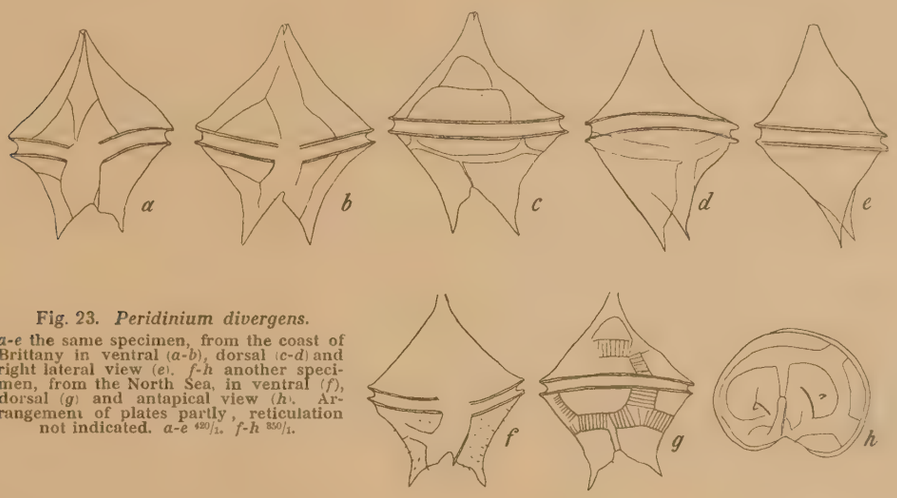

Fig. 23. *Peridinium divergens*.
a-e the same specimen, from the coast of Brittany in ventral (*a-b*), dorsal (*c-d*) and right lateral view (*e*). *f-h* another specimen, from the North Sea, in ventral (*f*), dorsal (*g*) and antapical view (*h*). Arrangement of plates partly, reticulation not indicated. *a-e* $^{420}/_1$. *f-h* $^{350}/_1$.

to the present species, "lorica cordato-ovata" especially is not correct for the following species, which is not ovate.

P. divergens is common in the Danish waters, also in the Western Baltic. It seems to be a neritic species.

20. **Peridinium crassipes** KOFOID 1907, p. 309, tab. XXXI, fig. 46—47. *P. divergens* SCHÜTT 1895 tab. XII, fig. 43, 1—2, tab. XIII, fig. 43, 18. non caet. SCHÜTT 1896, p. 22, fig. 32, et auct. plur., vix Ehrenberg

Related to the preceding species, but as shown in fig. 24, larger, shorter and broader. The protuberances of the antapical horns are more prominent than in *P. divergens*, and they are nearer to the ends of the horns. In some positions (figs. *e*, *f*) of the cell the horns are seen to terminate in a blunt semitruncated projection with two or three acuminate points. The surface is coarsely reticulate and spiniferous. The cell-content is yellow, often with red drops or lumps of oil.

Length 87—98 μ, KOFOID has 80—90 μ.

P. crassipes is an oceanic species, common in the temperate Atlantic. It occurs not seldom in the North Sea and the Skagerak.

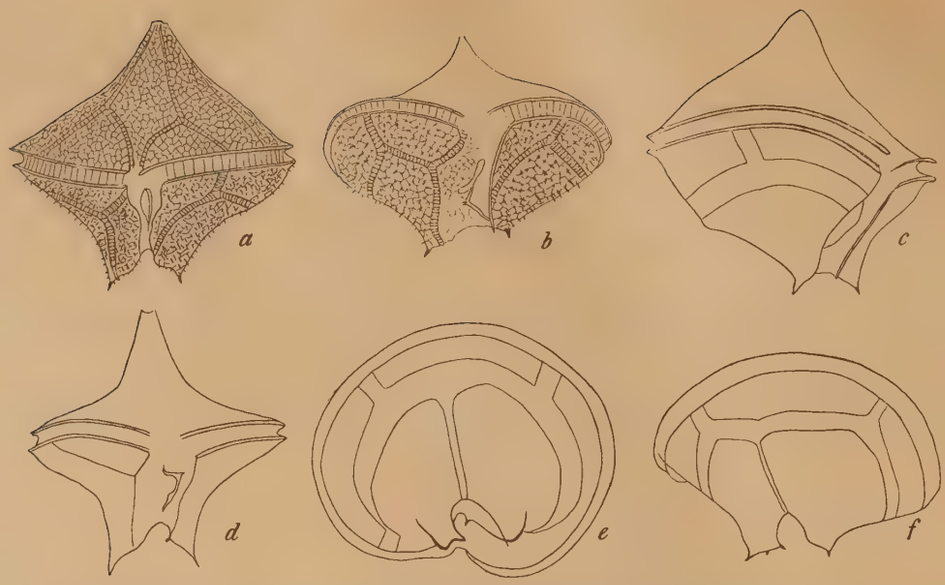

Fig. 24. *Peridinium crassipes.*
d from the Murman Coast, the other (one specimen) from Iceland, in ventral (*a*), ventral-antapical (*b*), ventral right side (*c*), antapical (*e*) and dorso-antapical view (*f*). Reticulation only indicated in *a* and *b*. ab. $^{420}/_{1}$.

21. **Peridinium conicum** (Gran) Ostf. & Schmidt 1901, p. 174, Gran 1902, p. 185, 190, fig. 14. *P. divergens* var. *conicum* Gran 1900, p. 47.

Not seldom in the Danish waters, occurring also in the Baltic.

22. **Peridinium conicoides** Paulsen 1905, p. 3, fig. 1.

In the Danish waters found once only: in the Kattegat in December 1903.

23. **Peridinium pentagonum** Gran 1902, p. 185, 190, fig. 15.

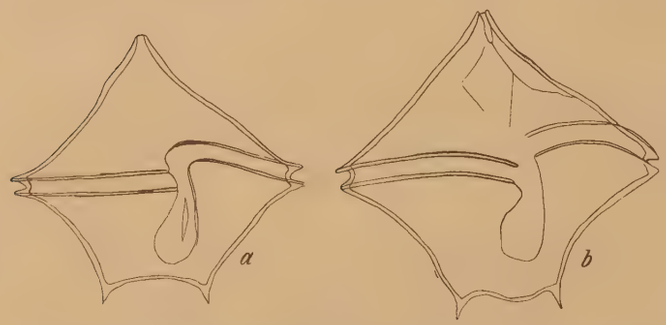

Fig. 25. *Peridinium pentagonum.*
a from Iceland, *b* from the great Belt. Arrangement of plates not indicated. $^{420}/_{1}$.

I give figures (fig. 25) of specimens with antapical spines, — such forms seem to be more frequent than the unarmed form drawn by Gran. The most characteristic feature of this species is its obliquity, the left side being thinner than the right (seen from the end of the cell). The cell contains red lumps (of oil?).

Rare in the Danish waters.

24. **Peridinium subinermis** Paulsen 1905, p. 24, fig. 10.

Danish specimens are a little different from the Icelandic ones previously described by me. Fig. 26 *a—c* shows that the antapical spines are rather prominent. The ridge which supports them often coïncides with the suture-line, which forms a curve round the end of the longitudinal furrow. Thus the furrow is situated in a depression (fig. 26 *a, c, e,* 27 *a, b, d, f*). The membrane seems smooth, or it is finely reticulate. Length 56—68 μ.

Fig. 26 *d-e* represents a lower form. The membrane is distinctly reticulate, with fine spines where the meshes meet.

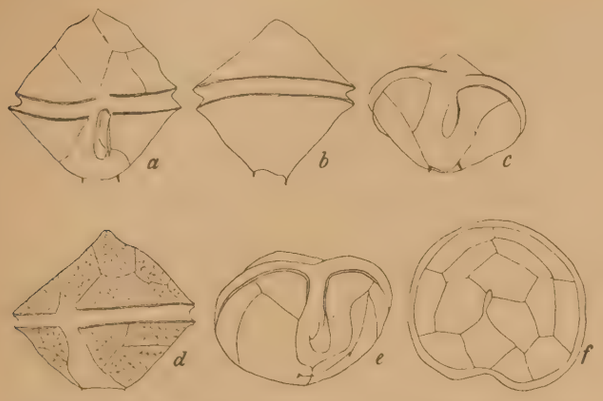

Fig. 26. *Peridinium subinermis* from the Skagerak except *f*, which is an Icelandic specimen.
a-c one specimen in ventral *(a)*, dorsal *(b)* and ventral-antapical view *(c)*. *d-e* another specimen in left-ventral and ventral-antapical view. *f* apical view. $^{430}/_{1}$.

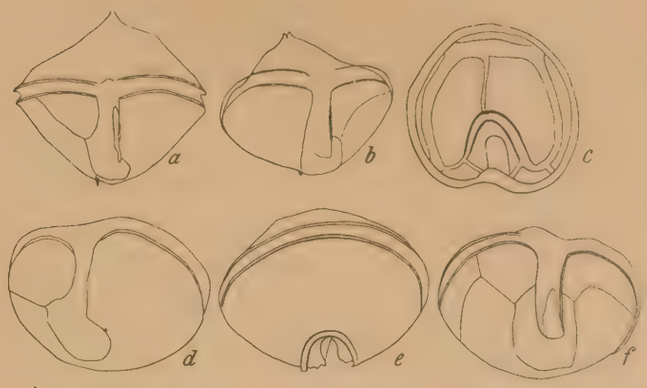

Fig. 27. *Peridinium subinermis* from the Skagerak.
a, b, d one specimen in ventral and antapical view. *c, e. f* other specimens in antapical, dorsal antapical and ventral-antapical view. Sutures partly indicated, reticulation like in fig. 26 *d*, not indicated. [illegible].

Fig. 27 must be referred to the same species although a little different in shape. The reticulation is like that of the preceding.

I have found *P. subinermis* repeatedly and abundantly in the North Sea and the Skagerak in the spring.

25. **Peridinium punctulatum** n. sp. (fig. 28).

Closely related to the preceding, the shape of the cell is about the same as that of the low form of *P. subinermis*. Antapical spines none or insignificant, a ridge on the bottom-plates is sometimes to be found (fig. 22 *f, h*), but it does not coincide with the suture. The depression round the longitudinal furrow is narrow.

I should be inclined to unite this species to the preceding were it not for the absence of reticulation. The finely dotted membrane (fig. *a*) is the best characteristic of this species in comparison with *P. subinermis*. Length 52—62 μ. Greatest diameter 60—72 μ. Colour of cell-content not yet ascertained.

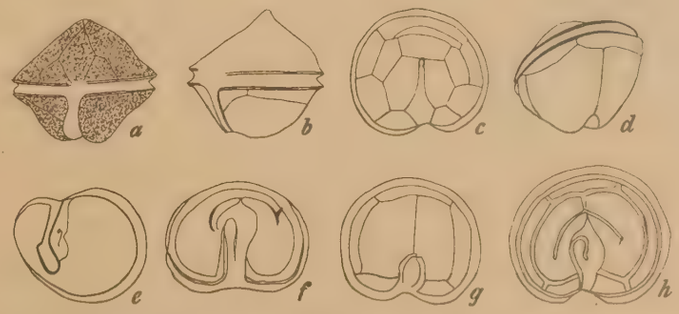

Fig. 28. *Peridinium punctulatum* from the North Sea, different specimens. *a* ventral, *b* side view, *c* apical, *d-h* different antapical views. Punctation indicated only in *a*. $^{340}/_{1}$.

I have found *P. punctulatum* repeatedly and in abundance in the southern North Sea and off the Coast of Jutland in summer time.

Fig. 29. *Peridinium achromaticum* from the Eastern Baltic. After a drawing by Dr. Levander.

26. **Peridinium achromaticum** Levander 1902, p. 49, fig. 1—2.

The annexed figure (29) is drawn by Dr. Levander who has been so kind as to permit me to publish it.

Baltic species, found rarely in the Danish waters: in the Sound and Kattegat.

27. **Peridinium Thorianum** Paulsen 1905, p. 3, fig. 1.

In the Danish waters found in the North Sea and the Skagerak. Rare.

28. **Peridinium catenatum** Levander 1894, 2.

According to Mr. Ostenfeld this interesting species has been found rarely in the Lim Fjord.

XI. *Oxytoxum* Stein.

In "Bulletin des résultats acquis ..." I find an "*Oxytoxum* sp." noted from the Kattegat (November 1902).

XII. *Pyrophacus* Stein.

Pyrophacus horologicum Stein 1883, tab. XXIV, fig. 1—13, tab. XXV, fig. 1. Schütt 1895, tab. XVII, fig. 51.

Common in the North Sea, the Kattegat and the Skagerak, mostly in the autumn. Not found in the Belts nor in the Western Baltic.

XIII. *Ceratium* Schrank.

Key to the species:

I. Only two horns distinctly present: one apical and one antapical ..... 1. *C. fusus.*
II. Three horns present: one apical and two antapicals.
A. The horns are all straight.
1. Cell broad, distance between the antapical horns considerable ..... 4. *C. candelabrum.*
2. Cell slender, antapical horns near to each other.
a. The lower edge of the cell (between the antapical horns) is nearly parallel to the girdle and sharply limited by two angles ..... 3. *C. lineatum.*
b. The lower edge of the cell is more oblique to the girdle and, at least at one end, curves over into the antapical horn ..... 2. *C. furca.*
B. The antapical horns are curved forward.
1. Apical horn straight.
a. Antapical horns as a rule pointed (closed at the end), not spiniferous.
α. Antapical horns distinctly bent inwards, their prolongations and that of the apical horn intersecting ..... 6. *C. bucephalum.*
β. Antapical horns not bent inwards ..... 5. *C. tripos.*
b. Antapical horns open at the end. Spines sometimes present.
α. The bases of the antapical horns are marked off below the lower edge of the cell. Horns often spiniferous ..... 7. *C. macroceros.*
β. The bases of the antapical horns are not marked off below the cell.
x Distal end of antapical horns fairly parallel to the apical horn ... 8. *C. intermedium.*
xx Distal end of antapical horns bent outwards and as a rule curved outward ..... 10. *C. batavum.*
2. Apical horn curved. Spines often present.
a Antapical horns in their whole course curved inwards ..... 9. *C. longipes.*
b. Distal end of antapical horns (at least one of them) straight or bent outwards 10. *C. batavum.*

1. **Ceratium fusus** (Ehbg.) Clap. & Laghm. 1859, p. 400, tab. 19, fig. 7. *Peridinium fusus* Ehrenberg 1833, p. 271, 1838, p. 256, tab. 22, fig. 20. *P. seta* Ehrenberg 1859, p. 792, 1873, p. 3, fig. 5—6. *Amphiceratium fusus* (Ehrenberg) Vanhöffen 1899.

Common in the North Sea, the Kattegat, and in the Western Baltic.

2. **Ceratium furca** (Ehbg.) Clap. & Lachm. 1859, p. 399, tab. 19, fig. 5. *Peridinium furca* Ehrenberg 1833, p. 270, 1838, p. 256, tab. 22, fig. 21. *P. eugrammum* Ehrenberg 1859, p. 792, 1873, fig. 4. *Biceratium furca* (Duj.) Vanhöffen 1899.

Common in the North Sea, the Kattegat, sparingly in the Western Baltic.

3. **Ceratium lineatum** (Ehbg.) Cleve 1899, p. 36. *Peridinium lineatum* Ehrenberg 1854, tab. 25, C, 1854, 2, p. 240. *C. furca* var. *baltica* Moebius. *Biceratium debile* Vanhöffen 1899.

Occurs in the Danish waters mostly in the autumn, seldom in great quantities. Sparingly in the Baltic.

4. **Ceratium Candelabrum** (Ehbg.) Stein 1883, tab. XV, fig. 15—16. *Peridinium Candelabrum* Ehrenberg 1859, p. 792, 1873, p. 3, fig. 2—3.

Found once only: at Skagen (Febr. 16th 1903).

5. **Ceratium tripos** (O. Fr. Müller) Nitzch. 1817, p. 4 Anm. *Cercaria tripos* O. Fr. Müller 1781, p. 206, 1786, p. 136, tab. XIX, fig. 22.

Of this species Ostenfeld has described (1903) two "forms", viz. f. *atlantica* and f. *subsalsa* (partially identical with var. *baltica* Schütt). The latter, "the Baltic and Kattegat form" has the antapicals straight or nearly so, forming an angle at their basal part, whereas the horns of f. *atlantica* are more spreading and evenly but faintly curved. This difference seems to be constant, and Ostenfeld considers the two forms as "geographical races". As such I believe they should be considered as varieties, forms being more closely dependent on the exterior and not constant, as e. g. seasonal forms.

As shown by Ostenfeld, *C. tripos* var. *subsalsa* is the common one in the Danish waters, it occurs everywhere in great masses in the autumn.

C. tripos var. *atlantica* seems to be rare. Fig. 30 represents a specimen taken at Skagen in May 1906. The difference between this and the specimen figured by Ostenfeld from the Faeroes is slight.

Fig. 30. *Ceratium tripos* var. *atlantica* from Skagen. $^{87}/_{1}$.

An easily distinguishable seasonal form of *C. tripos* is: f. *hiemalis* n. f., characterized by the narrow space between the elongated horns, the antapicals being as a rule more or less straight and almost parallel to the apical. It has been recorded in "Bulletin" as *C. tripos* var. Fig. 31 shows some differences in the appearance of specimens belonging to this form. Some of them (*b, c, f*) are only a little contracted, being rather like the type var. *subsalsa*, others (*a, d*) are different. The specimens with curved antapicals (*e, g*) could be considered as belonging to var. *atlantica*.

Fig. 31 *d* is remarkable by the antapicals being open at the end, a phenomenon very seldom in the *tripos*-group. Fig. *g* represents a specimen approaching to *C. bucephalum*, but with only one antapical horn near to the apical one and prolonged.

All the figures show that the characters of f. *hiemalis* are not constant. It is a true seasonal form, occurring only in winter and spring.

6. **Ceratium bucephalum** (Cleve) Cleve 1900, p. 211. *C. tripos* var. *bucephalum* Cleve 1897, p. 302, tab. VIII, fig. 5. *C. arcuatum* Jørgensen 1899, p. 44, Vanhöffen 1897, tab. V (partim), non Gourr.

Occurs in summer and autumn in the North Sea, the Skagerak and the Kattegat, not in the Belts nor in the Baltic.

Fig. 31. *Ceratium tripos* f. *hiemale* from Kattegat (in May). $^{100}/_{1}$—$^{120}/_{1}$.

The nearly related species (— if a species? —) *C. heterocamptum* (Jörgs.) Ostf. & Schmidt,[1] I have not seen in the Danish waters, but as in some years it occurs abundantly off the west Coast of Norway (according to Jörgensen) it might be found here also. It is recognizable by one of the antapical horns being so strongly curved that its prolongation forms nearly a right angle with the apical horn.

7. **Ceratium macroceras** (Ehbg.) Cleve 1900, p. 227. *Peridinium macroceros* Ehrenberg 1840, p. 201 (?). *Ceratium tripos* var. *macroceros* Clap. Lachm. 1859, p. 397, tab. XIX, fig. 1.

Common in the North Sea, the Skagerak and the Kattegat, very seldom in the Belts, wanting in the Baltic.

8. **Ceratium intermedium** (Jörgensen) Jörgensen 1905, p. 111. *C. tripos* var. *macroceros* f. *intermedia* Jörgensen 1899, p. 42. *C. horridum* Gran 1902, p. 194, Ostenfeld 1903, p. 584, fig. 136—139, non Cleve. *C. tripos* var. *scotica* Ostenfeld 1899, p. 56, 1900, p. 55, vix Schütt 1893.

Common in the North Sea, the Skagerak and the Kattegat, rare in the Belts and in the Baltic.

Gran, and Ostenfeld with him, distinguishes two forms of what they called *C. horridum*, viz. var. (forma) *genuina* and var. (forma) *intermedia*, — Gran considers them as varieties, Ostenfeld as forms. Since the species ought to bear another name these forms must also change name. I propose to name them as follows:

f. *spinifera* n. nom. (= f. *genuina*) with spines especially on the apical horn.

f. *typica* n. nom. (= f. *intermedia*) without spines.

Of these two, f. *typica* seems to be more common in the Danish waters than f. *spinifera*. As to the biological relation between them I know nothing.

A third form of *C. intermedium* is

Fig. 32. *Ceratium intermedium* f. *frigida* from Skagerak.

f. *frigida* n. f., a seasonal form occurring in winter and spring and parallel to *C. tripos* f. *hiemale* (fig. 32). The horns are long, parallel to each other, and often slightly curved. — In spite of the curved apical horn this form seems to belong to *C. intermedium*, not to *C. longipes*.

9. **Ceratium longipes** (Bail.) Gran 1902, p. 52, 193, fig. 1. *C. tripos* var. *longipes* Cleve 1897, p. 302. tab. VIII, fig. 2. *Peridinium longipes* Bailey 1855, p. 12, fig. 35. *C. horridum* Cleve 1897, p. 302, tab. VIII, fig. 4, non Gran, nec Ostenfeld. *C. tripos* var. *tergestina* Schütt 1893, p. 70, fig. 20, IV b.

Common in the Danish waters, seldom if not wanting in the Baltic.

[1] 1901, p. 165. *C. tripos* var. *arcuatum* f. *heterocampta* Jørgensen 1899, p. 44, tab. II, fig. 12 *C.* (*tripos* var.) *arietinum* Cleve 1900, 2, p. 13, tab. VII, fig. 3.

OSTENFELD (1903) has described two forms of this species: f. *oceanica*, more robust and with shorter and more spiniferous horns, and f. *baltica*, slender and without spines. As these "forms" are geographical races, I believe they must be considered as varieties at least. Both are to be found in the Danish waters, but var. *baltica* is by far the commonest.

C. longipes var. *ventricosa* Ostenfeld (1903, p. 587, fig. 143) has been found in single specimens in the Skagerak. (Bull. trimestriel, Aug. 1905).

10. **Ceratium batavum** n. nom. (fig. 33). *C. tripos* var STEIN tab. XVII, fig. 1.

By this name I denote a species mentioned and figured by VAN BREEMEN (1905, p. 181 (37), fig. 9) as *Ceratium longipes* aff. It is really akin to this species, but the antapical horns are more bent outward and mostly more or less curved outward, at any rate one of them. The apical horn is straight or sometimes slightly curved. According to VAN BREEMEN the horns are prolonged in the autumn. Length 180—260 μ.

This species is very variable, but as suggested by VAN BREEMEN all variations can pretty well be distinguished from *C. intermedium* and *C. longipes*. *C. tripos* f. *gracilis* (Pouchet) Jörgensen (1899, p. 43) is, as communicated to me by Mr. JÖRGENSEN, a true *C. intermedium* with undulated antapical horns and does not belong to the present species, as VAN BREEMEN supposes.

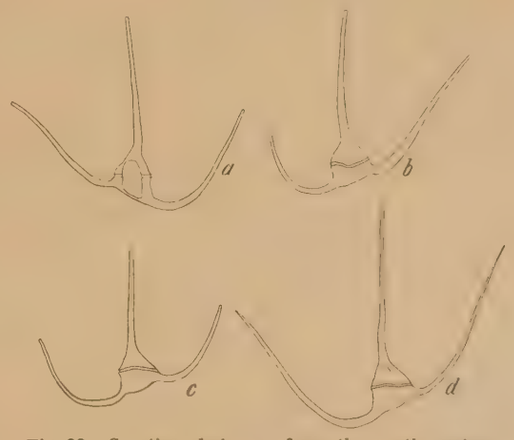

Fig. 33. *Ceratium batavum* from the south-western North Sea. ab. $^{180}/_{1}$.

The figures (33) have been drawn after specimens from the southwestern North Sea, sent to me by Dr. VAN BREEMEN. According to this investigator, *C. batavum* is a neritic species, common in the southwestern North Sea. Off the coast of Jutland I have found it in the autumn in considerable quantities.

XIV. *Podolampas* Stein.

Only one species in the Danish waters:

Podolampas palmipes STEIN 1883, tab. VIII, fig. 9—11. SCHÜTT 1895, tab. XVIII, fig. 58.

A specimen measured was 104 μ long (body alone), the longer spine being 32 μ long.
Rare in the Danish waters, found in a single specimen in the Skagerak.

XV. *Gymnodinium* (Stein) Schütt.

Key to the species:

I. Body apically pointed, distally rounded ..... *G. gracile.*
II. Body rhombic ..... *G. rhomboides.*

Gymnodinium gracile BERGH 1881, p. 251, fig. 68—68.

Described from the Little Belt.

Gymnodinium rhomboides SCHÜTT 1895, tab. XXI.

Found once in the Skagerak (Bulletin trimestriel, May 1905).
Probably more species could be found in the Danish waters.

XVI. *Spirodinium* Schütt.

Spirodinium spirale (Bergh) Schütt 1896, p. 5, fig. 6. *Gymnodinium spirale* Bergh 1881, p. 253 fig. 70—71.

Described from the Little Belt.

XVII. *Pouchetia* Schütt.

Pouchetia rosea (Pouch.) Schütt 1895, tab. XXVI, fig. 92. *Gymnodinium polyphemus* Pouchet var. *roseum* Pouchet 1887, p. 96, pl. X, fig. 1.

According to Mr. Ostenfeld found in single specimens in the North Sea off Thyborøn on the coast of Jutland.

XVIII. *Polykrikos* Bütschli.

Polykrikos Schwartzii Bütschli 1873, p. 673, tab. 26, fig. 22. Kofoid 1907, 2. *P. auricularia* Bergh 1881, p. 256, fig. 72—73.

Seems not to be seldom in the Danish waters.

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